1. An engineering research team is studying the relationship between the compressive strength of concrete and the load-bearing capacity of beams used in mid-rise buildings. They collected data from 15 different concrete beam samples. Each sample was tested to measure its compressive strength (in MPa) and the maximum load it could bear before failure (in kN). The collected data is shown in the table below:
   a. Create a scatter plot of the data to visually examine the relationship between compressive strength and load-bearing capacity.
   b. Determine the equation of the regression line of Y on X that best fits the data.
   Calculate the coefficient of correlation (r) to measure the strength and direction of the linear relationship.
   c. Interpret the results. What does the regression line tell you? Is the correlation strong? What can you conclude about the relationship between compressive strength and beam load capacity?
   d. Prediction: Using the regression line, estimate the load-bearing capacity of a beam with a compressive strength of 34 MPa.

Sample	X (Compressive Strength, MPa)	Y (Load-Bearing Capacity, kN)
1	20	55
2	22	60
3	25	66
4	23	62
5	27	70
6	30	75
7	28	73
8	24	64
9	26	68
10	32	80
11	35	85
12	33	82
13	31	78
14	29	74
15	21	58

2. A transportation engineering team is studying the relationship between asphalt pavement thickness and the deflection of the pavement under a standard wheel load. They hypothesize that thicker pavement results in lower deflection, which improves road durability. They conducted tests on 15 different pavement sections, measuring the thickness of the asphalt layer (in centimeters) and the corresponding deflection under load (in millimeters).
   a. Plot the data on a scatter plot to visualize the relationship between pavement thickness and deflection.
   b. Determine the regression line equation of X on Y that models the relationship.
   c. Calculate the correlation coefficient (r) and interpret its meaning.
   d. If the engineers want a pavement section to have a deflection no more than 1.50 mm, estimate the minimum required thickness based on your model.

Sample	X (Pavement Thickness, cm)	Y (Deflection under Load, mm)
1	5.0	1.85
2	6.0	1.70
3	5.5	1.75
4	6.5	1.60
5	7.0	1.50
6	8.0	1.40
7	9.0	1.30
8	4.5	2.00
9	7.5	1.45
10	6.8	1.55
11	8.5	1.35
12	5.2	1.82
13	7.2	1.48
14	6.3	1.62
15	5.8	1.76

1. Concrete Strength

The compressive strength of concrete in a batch follows a normal distribution with a mean of 28 MPa and a standard deviation of 2.5 MPa.
Question: What is the probability that a randomly selected concrete sample has a strength greater than 30 MPa?

2. Beam Lengths

The length of steel beams produced by a factory is normally distributed with a mean of 6.0 meters and a standard deviation of 0.12 meters.
Question: What percentage of beams are shorter than 5.85 meters?

3. Bridge Lifespan

The lifespan of a certain type of bridge is normally distributed with a mean of 75 years and a standard deviation of 8 years.
Question: What is the probability that a randomly chosen bridge lasts between 70 and 80 years?

4. Pipe Diameter

A batch of PVC pipes has diameters that are normally distributed with a mean of 100 mm and a standard deviation of 3 mm.
Question: What is the probability that a pipe has a diameter less than 96 mm?

5. Cement Bag Weight

Cement bags are filled to an average weight of 50 kg, with a standard deviation of 1.5 kg. The weights are normally distributed.
Question: What proportion of bags weigh more than 52.5 kg?

6. Daily Rainfall

In a city, daily rainfall (in mm) during the rainy season follows a normal distribution with a mean of 12 mm and a standard deviation of 4 mm.
Question: On how many days out of 100 can you expect rainfall to exceed 18 mm?

7. Floor Tile Thickness

The thickness of ceramic floor tiles is normally distributed with a mean of 1.2 cm and a standard deviation of 0.05 cm.
Question: What percentage of tiles are between 1.15 cm and 1.30 cm thick?

8. Road Width

The width of a newly constructed road segment is normally distributed with a mean of 3.5 meters and a standard deviation of 0.1 meter.
Question: What is the probability that a random measurement shows a width greater than 3.7 meters?

9. Rebar Length

The length of rebar used in construction is normally distributed with a mean of 12 meters and a standard deviation of 0.2 meters.
Question: What is the length below which the shortest 5% of rebars fall?

10. Construction Worker Heights

The heights of male construction workers in a firm are normally distributed with a mean of 170 cm and a standard deviation of 6 cm.
Question: What is the probability that a randomly selected worker is taller than 180 cm?

11. A civil engineering student is conducting an experiment on the workability of fresh concrete using the slump test. The slump values (in millimeters) from 30 different concrete batches are shown in the table below:

Sample 1–5	Sample 6–10	Sample 11–15	Sample 16–20	Sample 21–25
75	80	70	90	85
65	78	72	88	82
70	76	74	92	87
68	77	73	95	84
66	79	69	89	81
71	83	67	91	86

a. Compute the mean and standard deviation of the slump values.

b. Assume the slump values follow a normal distribution. What is the probability that a randomly selected slump value:

i. Exceeds 85 mm?

ii. Is between 70 mm and 80 mm?

c. The acceptable slump range for the project is 65 mm to 90 mm.

i. How many of the 30 batches fall within this acceptable range?

ii. What percentage of the total is this?